

THE ORIGIN AND POSSIBLE EVOLUTION OF SUB-TASSEL EARS IN MAIZE

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MODERN maize has many vestiges which may reflect primitive characteristics of wild maize and its relatives. One of the least mentioned and possibly most significant rudiments in modern maize is the remains of a spathe subtending the lowermost tassel branch or pair of tassel branches. Anderson (1951) has described this vestige as "a kind of little ridge or scar as if a leaf had started to grow out and then had been pulled off." Sometimes this spathe is well-developed and associated with a small sub-tassel ear, as is evident in at least two published illustrations (Häckel, 1887; Weatherwax, 1916—fig. 10). Such an ear near the base of the tassel may be derived from a single staminate spikelet (Weatherwax, 1925).

An examination of over 1000 tassels from varieties of maize from North, Central and South America in the Maize Herbarium of Dr. Paul C. Mangelsdorf revealed a series of types ranging from a reduced and sometimes adnate spathe subtending the lowermost tassel branch to a fully developed leaf borne at a node with a small sub-tassel ear. The adnate or vestigial spathe and its derivations were found in over 70 per cent of the population studied. Sub-tassel spathe development was especially

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frequent and pronounced in varieties from Bolivia and Peru. This feature is enhanced by tassel proliferation resulting from unfavorable photoperiods during floral differentiation of short-day maize and is also characteristic of tunicate, corn-grass and teopod maize. Tassels which were proliferated or associated with any of the above variants were excluded from this study.

Specimens of *Tripsacum* and *Euchlaena* from the Economic Herbarium of Oakes Ames were examined in an attempt to determine if this rudimentary spathe might be derived from introgression with these near relatives of maize. It was found that in *Tripsacum pilosum*, *T. lanceolatum*, *T. dactyloides* and *T. fasciculatum* there is a small ridge encircling the base of the inflorescence. In these species, with *T. dactyloides* as a possible exception, the ridge is more in the nature of a fracture line for the lowermost rachis-fruit case than that of a vestigial leaf. In *Euchlaena mexicana* there is often a small leaf-like protrusion subtending the lowermost tassel branch. This structure is probably a vestigial spathe since its homologue subtending a lateral pistillate spike is a well-developed spathe. The degree of development of the spathe subtending the tassel of *Euchlaena* appears to be, on the average, intermediate between that of *Tripsacum* and that of maize.

In modern maize, partial development of the subtassel spathe and its axillary branch is usually associated with various anomalies. Both the spathe and its axillary peduncle may be adnate to the rachis. The peduncle may adhere to the rachis over a greater distance than its subtending spathe (Figs. 1-3). The auricles of the spathe may be greatly elongated on either side of a reduced blade (Figs. 4-6). Development of the spathe may be unilateral in relation to the branch, so that it appears as if its blade had been cleaved down the midrib and torn

off on one side (Figs. 7–9). Various twisted configurations may distort the spathe, rachis, and peduncle as the branch tends to become opposite rather than adjacent to its associated spathe (Figs. 10–13). If the axillary branch develops to one side of, or on the opposite side of, the node at which a terminal leaf would normally be expected, then both spathe-leaf and branch may achieve optimum development (Fig. 14). Two leaves, or a leaf and a sheath (husk), may be borne at this node. Such a pair of leaves (Figs. 15, 17) may have a common origin (Figs. 7–9), although distortion of the node may cause them to appear as being separated by a short and twisted internode (Fig. 13). In extreme cases of spathe development, a single spikelet or the tassel branch as a whole may be modified to form a small shank terminated by a small ear (Figs. 15–17). The morphological change from either a spikelet or tassel branch to a many-ranked ear involves a change from bilateral to radial symmetry. Such a transformation is common in maize. Depauperate ears frequently exhibit reductions from a radial to a bilateral condition. One might expect that, if there were a reduction during evolution of a leaf terminal to the culm, then there might also be a corresponding reduction of its axillary ear to a bilateral tassel branch.

Archaeological remains have been found which suggest that sub-tassel ear development may have been characteristic of primitive maize (Mangelsdorf, 1954 and unpub.). This evidence, so far as it goes, indicates that the tassel of wild maize was unbranched or sparsely branched and bore a few pistillate spikelets basally. The spathe subtending the tassel may have had a protective function for these pistillate spikelets during the prepollination period. Subsequent to pollination, rapid elongation above the sub-tassel node might elevate the mature grain for dispersal. Mangelsdorf has suggested (unpub.)

EXPLANATION OF THE ILLUSTRATION

PLATE XLIII. 1, 2, 3, profile, front and rear views respectively, of the divergence point of the lowermost peduncle from the rachis and its subtending spathe-rudiments which are adnate to the rachis. Natural size.

4, 5, 6, as in previous figures, with the addition of abnormally elongated auricles to an otherwise inhibited spathe. Natural size.

7, 8, 9, as in previous figures, showing cleavage of the spathe followed by unilateral development. Natural size.

10, 11, 12, as in previous figures, except for the equal development of the rudimentary parts of the spathe. Natural size.

13, unilateral spathe development at a twisted and elongated node. One half natural size.

14, tassel branch development on the opposite side of the node from its associated spathe. One half natural size.

15, sub-tassel ear development from a modified sessile staminate spikelet. Two leaves, probably of common origin, are borne at this node. One half natural size.

16, sub-tassel ear borne opposite a leaf at the same node. One half natural size.

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